

Appl. No. 09/884,147
Reply to Official Action mailed on October 19, 2004

Amendments to the Claims:

The listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

Claim 1 (original) A semiconductor laser module comprising:

- a semiconductor laser element;
- a thermo-module for adjusting the temperature of the semiconductor laser element in dependence upon an amount of current flowing into said thermo-module; and,
- at least one of an overcurrent limiting circuit to suppress an overcurrent flowing into the thermo-module and an overvoltage limiting circuit to suppress application of an overvoltage across said thermo-module.

Claim 2 (previously presented) A semiconductor laser module as defined in Claim 1, comprising an optical fiber optically coupled for receiving laser light emitted from the semiconductor laser element.

Claim 3 (previously presented) A semiconductor laser module as defined in Claim 2, wherein the thermo-module is configured to support the semiconductor laser element via solder, and comprising a reverse current flow prevention circuit for preventing current oriented for causing melting of the solder.

Claim 4 (cancelled)

Claim 5 (previously presented) A semiconductor laser module as defined in Claim 3, comprising a surge suppression circuit for preventing surge current from flowing into said thermo-module.

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Claim 6 (previously presented) A semiconductor laser module as defined in Claim 2, wherein the thermo-module comprises:

at least an element for alternatively heating and cooling in dependence upon a direction of current flowing therein, and wherein the overcurrent limiting circuit is electrically coupled with the at least an element to divert current flowing thereto and oriented for causing heating of the semiconductor laser element.

Claim 7 (previously presented) A semiconductor laser module as defined in Claim 2, wherein the overcurrent limiting circuit includes:

a diode disposed serially to the thermo-module and oriented for allowing current to flow therethrough when the flowing current is oriented in a direction for causing cooling of the semiconductor laser element; and

a current limiting circuit element coupled in parallel to the thermo-module.

Claim 8 (original) A semiconductor laser module as defined in Claim 7, wherein the overcurrent limiting circuit includes a capacitor disposed in a bypass circuit parallel to the thermo-module.

Claim 9 (previously presented) A semiconductor laser module as defined in Claim 6, wherein the overcurrent limiting circuit includes:

a bypass channel between an upstream side and a downstream side of the thermo-module for bypassing the thermo-module; and

a diode disposed within the bypass channel and oriented for allowing current to flow therethrough when the flowing current is oriented in a direction for causing heating of the semiconductor laser element;

wherein in use circuit elements within the bypass channel and the diode provide an overcurrent limiting circuit to relieve the flow of an overcurrent in the direction for causing heating of the semiconductor laser element.

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Claim 10 (original) A semiconductor laser module as defined in Claim 9, wherein the overcurrent limiting circuit includes a resistor disposed within the bypass channel serially to the diode.

Claim 11 (original) A semiconductor laser module as defined in Claim 10, comprising a surge suppression circuit in parallel to the bypass path for preventing surge current from flowing into said thermo-module.

Claim 12 (previously presented) A semiconductor laser module as defined in Claim 9, wherein the overcurrent limiting circuit includes:

a zener diode disposed serially to the diode within the bypass channel and oriented opposite to the diode for providing an approximately fixed zener voltage when the flowing current is oriented in a direction for causing heating of the semiconductor laser element;

wherein in use the bypass channel, zener diode and diode provide an overcurrent limiting circuit to relieve the flow of an overcurrent in the heating direction into said thermo-module.

Claim 13 (original) A semiconductor laser module as defined in Claim 12, comprising a surge suppression circuit in parallel to the bypass path for preventing surge current from flowing into said thermo-module.

Claim 14 (original) A semiconductor laser module as defined in Claim 13 wherein the surge suppression circuit comprises a capacitor.

Claim 15 (previously presented) A semiconductor laser module as defined in Claim 12 comprising:

a package for storing therein the semiconductor laser element and the thermo-module, the thermo-module being mounted on a first plate of the package, wherein the thermo-module comprises a first substrate adjacent the first plate, a second substrate and a Peltier element disposed therebetween.

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wherein the semiconductor laser element is disposed on the second substrate and thermally connected to said thermo-module and

wherein the overcurrent limiting circuit is disposed on at least one of the first substrate and the first plate.

Claim 16 (previously presented) A semiconductor laser module as defined in Claim 2 comprising:

a package for storing therein the semiconductor laser element and the thermo-module, the thermo-module being mounted on a first plate of the package, wherein the thermo-module comprises a first substrate adjacent the first plate, a second substrate and a Peltier element disposed therebetween;

wherein the semiconductor laser element is disposed on the second substrate and thermally connected to said thermo-module and

wherein the overcurrent limiting circuit is disposed on at least one of the first substrate and the first plate.

Claim 17 (original) A semiconductor laser module as defined in Claim 16 wherein:

said thermo-module is arranged in such a manner that the first substrate is extended relative to the second substrate, and comprising a first conductor pattern and a second conductor pattern of said thermo-module disposed on an extended portion of the first substrate and

wherein one end side of said overcurrent limiting circuit is coupled to said first conductor pattern and the other end side of said overcurrent limiting circuit is coupled to said second conductor pattern.

Claim 18 (previously presented) A semiconductor laser module as defined in Claim 16, comprising:

at least another Peltier element between the first substrate and second substrate; and,

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a lens configured to direct laser light emitted from the semiconductor laser element into the optical fiber, wherein said lens is thermally connected to the second substrate of said thermo-module.

Claims 19-20 (cancelled)

Claim 21 (previously presented) A semiconductor laser module as set forth in Claim 2 comprising:

a package having a through hole communicating from the inside of the package to the outside thereof for accommodating the semiconductor laser element and the thermo-module;

an optical fiber supporting member disposed within the through hole;

wherein an end portion side of the optical fiber is introduced from the outside of said package into the inside thereof via a through hole provided in said optical fiber supporting member.

Claim 22 (previously presented) A semiconductor laser module as defined in Claim 21, wherein the end portion side of the optical fiber is formed into a lens and disposed so as to receive the laser light emitted from the semiconductor laser element.

Claim 23 (previously presented) A semiconductor laser module as defined in Claim 9 comprising:

a package for storing therein the semiconductor laser element and the thermo-module, the thermo-module being mounted on a first plate of the package, wherein the thermo-module comprises a first substrate adjacent the first plate, a second substrate and a Peltier element disposed therebetween;

wherein the semiconductor laser element is disposed on the second substrate and thermally connected to said thermo-module and

wherein the overcurrent limiting circuit is disposed on at least one of the first substrate and the first plate.

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Claim 24 (original) A semiconductor laser module as defined in Claim 23 wherein:

said thermo-module is arranged in such a manner that the first substrate is extended relative to the second substrate, and comprising a first conductor pattern and a second conductor pattern of said thermo-module disposed on an extended portion of the first substrate and

wherein one end side of said overcurrent limiting circuit is coupled to said first conductor pattern and the other end side of said overcurrent limiting circuit is coupled to said second conductor pattern.

Claim 25 (original) A method for driving a semiconductor laser module having a semiconductor laser element, and a thermo-module for adjusting the temperature of the semiconductor laser element comprising the steps of:

thermally connecting said thermo-module to said semiconductor laser element;

adjusting the temperature of the semiconductor laser element in dependence upon an amount of current flowing into the thermo-module; and

suppressing some of an overcurrent flowing into the thermo-module by providing an overcurrent flow limiting circuit for the thermo-module.

Claim 26 (original) A method for driving a semiconductor laser module as defined in Claim 25 wherein the thermo-module is constructed so that it provides heating and cooling in dependence upon an orientation of a current flow within the thermo-module and wherein the step of suppressing some of an overcurrent flowing into the thermo-module by providing an overcurrent flow limiting circuit for the thermo-module is performed only for current flowing in an orientation for causing heating.

Claim 27 (original) A method for driving a semiconductor laser module as defined in Claim 26 wherein the overcurrent flow limiting circuit comprises a bypass path in parallel to the thermo-module and wherein the step of suppressing some of an overcurrent flowing into the thermo-module by providing an overcurrent flow limiting circuit for the thermo-module is

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performed only when more than a predetermined voltage is provided across the thermo-module.

Claim 28 (original) A method for driving a semiconductor laser module as defined in Claim 27 wherein the overcurrent flow limiting circuit comprises a zener diode within the bypass path for maintaining the voltage across the thermo-module below a predetermined voltage.

Claim 29 (original) A method for driving a semiconductor laser module as defined in Claim 26 wherein the overcurrent flow limiting circuit comprises a bypass path in parallel to the thermo-module and wherein the step of suppressing some of an overcurrent flowing into the thermo-module by providing an overcurrent flow limiting circuit for the thermo-module is performed only when a surge current having high frequency components is provided to the thermo-module.

Claim 30 (original) A method for driving a semiconductor laser module as defined in Claim 26 wherein the overcurrent flow limiting circuit comprises a bypass path in parallel to the thermo-module comprising a resistor and wherein the step of suppressing some of an overcurrent flowing into the thermo-module by providing an overcurrent flow limiting circuit for the thermo-module is performed by redirecting an approximately fixed fraction of current flow within the thermo-module in the heating direction to the bypass path.

Claim 31 (previously presented) A transmission device comprising:

- an optical element;
- a thermo-module configured to support the optical element and to variably adjust the temperature of the optical element in dependence upon an amount of a current flowing into said thermo-module; and

- at least one of an overcurrent limiting circuit configured to suppress an overcurrent from flowing into said thermo-module; and an overvoltage limiting circuit configured to suppress an overvoltage from being applied to said thermo-module.

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Claim 32 (previously presented) A transmission device as set forth in Claim 31, wherein at least one of the overcurrent limiting circuit and the overvoltage limiting circuit is provided in a power source apparatus.

Claim 33 (previously presented) A transmission device as set forth in Claim 31, wherein at least one of the overcurrent limiting circuit and the overvoltage limiting circuit comprises a diode oriented for allowing current to flow therethrough when the flowing current is oriented in a direction for causing heating of the semiconductor laser element and a Zener diode oriented opposite to the orientation of the diode, the diode and the zener diode coupled in series in parallel to the thermo-module.

Claim 34 (original) A transmission device as set forth in Claim 33, wherein said overcurrent limiting circuit is disposed in the power source device of said optical module.

Claim 35 (cancelled)

Claim 36 (previously presented) A semiconductor laser module as defined in Claim 5, wherein the surge suppression circuit comprises a diode disposed in series with said thermo-module.

Claim 37 (previously presented) A method of driving a semiconductor laser element optically coupled to an optical fiber and fixed on a thermo-module for adjusting the temperature of the semiconductor laser element, comprising the steps of:

- thermally connecting said thermo-module to said semiconductor laser element;
- adjusting the temperature of the semiconductor laser element in dependence upon an amount of current flowing into the thermo-module;
- providing an overcurrent flow limiting circuit including a bypass path disposed in parallel to the thermo-module; and
- suppressing an overcurrent flowing into the thermo-module in an orientation for causing heating of the semiconductor laser element.

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Claim 38 (previously presented) A method of claim 37, wherein said semiconductor laser element is fixed on said thermo-module by use of solder.

Claim 39 (previously presented) A method of claim 38, wherein said suppressing an overcurrent flowing into the thermo-module is performed when more than a predetermined voltage is provided across the thermo-module,

Claim 40 (previously presented) A method of claim 39 wherein, said providing an overcurrent flow limiting circuit includes providing a zener diode within the bypass path for maintaining the voltage across the thermo-module below a predetermined voltage.

Claim 41 (previously presented) A method of claim 38, wherein said suppressing an overcurrent flowing into the thermo-module is performed when a surge current is provided to the thermo-module,

Claim 42 (previously presented) A method of claim 38, wherein said providing an overcurrent flow limiting circuit includes providing a resistor within the bypass path; and wherein said suppressing an overcurrent flowing into the thermo-module includes redirecting a fraction of current flow within the thermo-module in the heating direction to the bypass path.

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